Demonstrating Robotic Autonomy in NASA's Intelligent Systems Project (Abstract)

Robert Morris* Ben Smith** Tara Estlin** Liam Pedersen*

* NASA Ames Research Center
** NASA Jet Propulsion Lab

To accomplish the next generation of challenging missions, NASA must develop highly autonomous systems that can make critical decisions independently of operators. Utilizing autonomy technology will extend the boundary on what can be accomplished in future missions by overcoming limitations due to communications delays, light-speed constraints, mission complexity, and cost. Autonomous systems will enable future space missions by maintaining vehicle health and safety, accomplishing complex science and mission goals, and adapting to changing circumstances or opportunities.

The goal of the Automated Reasoning subproject of NASA's Intelligent Systems (IS) Project is to develop core technologies that facilitate the development of autonomous systems and to develop the infrastructure required to rapidly develop, test, verify and maintain these systems.

The culmination of NASA's investment in autonomy in the IS project will be a series of demonstrations in September 2004 of analogue rover science missions demonstrating key autonomy technologies enabling goal-directed systems for science exploration missions. Examples include integrated robotic technologies enabling contact instrument placement and vehicle positioning in one command cycle, as well as on-board autonomous instrument targeting capability based on discovery of serendipitous science opportunities. Key software technologies that will be demonstrated include automated planning and scheduling, science data priority assignment, robust execution systems, and automated mode estimation and diagnosis.

This paper will provide an overview of NASA's investments in autonomy during the past five years within the Intelligent Systems Project, with particular attention paid to investments that have resulted in mission infusion of autonomy technology, in particular, into the recent Mars Exploration Rover (MER) mission. The content of the paper will be divided into two primary topic areas: a technical overview of the component technologies developed under the program, and a programmatic overview of the history and organization of the NASA IS project itself, with a focus on describing the program elements related to autonomy and intelligent robotics. The paper will also provide an overview of the September 2004 autonomy demonstrations, including a discussion of objectives, organization, and preliminary results (to the extent they are available before the submission deadline).